DACA42-02-C-0001

LOGANEnergy Corp.

Fort Bragg Army Environmental Center
Fayetteville, North Carolina
PEM Demonstration Program

Midterm Report

Proton Exchange Membrane (PEM) Fuel Cell Demonstration
Of Domestically Produced PEM Fuel Cells in Military Facilities

US Army Corps of Engineers
Engineer Research and Development Center
Construction Engineering Research Laboratory
Broad Agency Announcement CERL-BAA-FY01

Fort Bragg Army Base
Fayetteville, North Carolina

May 12, 2004

Executive Summary

In October 2001, LOGANEnergy Corporation received a contract award from the US Army Corps of Engineers, Construction Engineering Research Lab to test and evaluate Proton Exchange Membrane (PEM) Fuel Cells at several DOD sites. Ft. Bragg Army Base in Fayetteville, NC was one of the sites awarded to LOGAN and this installation is in its final phase. The initial start-up took place September 30, 2002.

The demonstration site is located at the Ft Bragg Environmental Center. It is host to a 5 kilowatt 120/240 VAC, SU-1R PEM technology demonstration unit manufactured by Plug Power Corporation, Latham, NY. The unit, which is a factory-remanufactured product, is installed in a grid parallel/grid synchronized configuration and operates nominally at 2.5 kilowatts. The unit is instrumented with an external wattmeter and a gas flow meter. A phone line is connected to a data modem within the power plant to communicate to Plug Power with alarms or events requiring service and attention.

The Point of Contact for this project is Georges Dib. His phone number is (910) 396-7736.
The total estimated energy cost increase to the host site as a result in participating in this demonstration project is -$729.73.

Table of Contents

Proposal – Proton Exchange Membrane (PEM) Fuel Cell Demonstration of Domestically Produced Residential PEM Fuel Cells in Military Facilities

1.0 Descriptive Title

Environmental Center PEM Demonstration Program, Fort Bragg Army Base, Fayetteville, North Carolina

2.0 Name, Address and Related Company Information

LOGANEnergy Corporation

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BLDG 100- 175
Roswell, GA 30076
(770) 650- 6388

DUNS 01-562-6211
CAGE Code 09QC3
TIN 58-2292769

LOGANEnergy Corporation is a private Fuel Cell Energy Services company founded in 1994. LOGAN specializes in planning, developing, and maintaining fuel cell projects. In addition, the company works closely with manufacturers to implement their product commercialization strategies. Over the past decade, LOGAN has analyzed hundreds of fuel cell applications. The company has acquired technical skills and expertise by designing, installing and operating over 30 commercial and small-scale fuel cell projects totaling over 7 megawatts of power. These services have been provided to the Department of Defense, fuel cell manufacturers, utilities, and other commercial customers. Presently, LOGAN supports 30 PAFC and PEM fuel cell projects at 21 locations in 12 states, and has agreements to install 22 new projects in the US and the UK over the next 18 months.

3.0 Production Capability of the Manufacturer

Plug Power manufactures a line of PEM fuel cell products at its production facility in Latham, NY. The facility produces three lines of PEM products including the 5kW GenSys5C natural gas unit, the GenSys5P LP Gas unit, and the GenCor 5kW standby power system. The current facility has the capability of manufacturing 10,000 units annually. Plug will support this project by providing remote monitoring, telephonic field support, overnight parts supply, and customer support. These services are intended to enhance the reliability and performance of the unit and achieve the highest possible customer satisfaction. Scott Wilshire is the Plug Power point of contact for this project. His phone number is 518.782.7700 ex1338, and his email address is scott_wilshire@plugpower.com.

4.0 Principal Investigator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
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5.0 Authorized Negotiator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
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6.0 Past Relevant Performance Information

a) Contract: PC25 Fuel Cell Service and Maintenance Contract #X1237022

Merck & Company
Ms. Stephanie Chapman
Merck & Company
Bldg 53 Northside
Linden Ave. Gate
Linden, NJ 07036
(732) 594-1686

Contract: Four-year PC25 PM Services Maintenance Agreement.
In November 2002 Merck & Company issued a four-year contract to LOGAN to provide fuel cell service, maintenance and operational support for one PC25C fuel cell installed at their Rahway, NJ plant. During the contract period the power plant has operated at 94% availability. LOGAN performs the quarterly and annual service prescribed by the UTC, and performs other maintenance as required. The periods of unavailability are chiefly due to persistent inverter problems that seem to be endemic to the Toshiba power conditioning balance of the system. Field modifications and operating adjustments have largely cured the problem. Quarterly service events take 10 hours to complete with the unit under load, and the annual event takes approximately 35 hours with the unit shut down.

b) Contract: Plug Power Service and Maintenance Agreement to support one 5kWe GenSys 5C and one 5kWe GenSys 5P PEM power plant at NAS Patuxant River, MD.

Plug Power
Mr. Scott Wilshire.
968 Albany Shaker Rd.
Latham, NY 12110
(518) 782-7700 ex 1338

LOGAN performed the start-up of both units after Southern Maryland Electric Cooperative completed most of the installation work. The units are located at residential sites at Patuxant River Naval Air Station, MD and operate in standard gird connected/grid independent configurations. Both operate at 4.5kWe and have maintained 98% availability. The units, S/Ns 241 and 242 are two of the very latest GenSys models to reach the field. S/N 242 is Plug Power's first LPG fueled system to go into the field. Both have set new performance standards, and raised expectations for near term commercial viability for this product. Operations to date are indicative of the success of the various test and evaluation programs that have been conducted over the past two years.

c) Contract: A Partners LLC; Commercial PC25 Fuel Cell Project Design, Installation and 5-year service and maintenance agreement.

Mr. Ron Allison
A Partners LLC
1171 Fulton Mall
Fresno, CA 93721
(559) 233-3262

On April 20, 2004 LOGAN completed the installation of a 600kWe PC25C CHP fuel cell installation in Fresno, CA. The system operating configurations allow for both grid parallel and grid independent energy service. The grid independent system is integrated with a Multi Unit Load Sharing (MULS) electronics package and static switch, which initial development was funded by ERDC CERL in 1999. This is the third fuel cell installation that uses the MULS System. The thermal recovery package installed in the project includes a 100-ton chiller that captures 210 degree F thermal energy supplied by the three fuel cells to support cooling loads on the first three floors of the host facility. The fuel cells also provide low-grade waste heat at 140 degrees F that furnishes thermal energy to 98 water source heat pumps located throughout the 12-story building during the winter months.

7.0 Host Facility Information

Fort Bragg is located in Fayetteville, North Carolina, and is an "open" Army installation, which allows easy access for civilians. It was established in 1918 as Camp Bragg, an Army field artillery site named for the Confederate General Braxton Bragg. A year later, an aviation landing field named after 1st Lt. Harley H. Pope was added. Five years later, it was renamed Fort Bragg and became a permanent Army post. With Pope Air Force Base it is one of the world's largest military installations.
With more than 45,000 military personnel, Fort Bragg is the world's largest airborne facility. It is well known as the "home of the airborne," and is home to the 82nd Airborne Division, the XVIII Airborne Corps, and the U.S. Army Parachute Team (the Golden Knights).

The electricity provider for Fort Bragg is Progress Energy. The natural gas supplier is Piedmont Natural Gas, and Ft Bragg produces all of its own water from a series of wells located on the base.

8.0 Fuel Cell Installation

The installation site, seen in Figure 1 below is adjacent to the Ft Bragg Environmental Center, and proved to be convenient to water, power and natural gas utility services. The facility includes office space and an environmental testing laboratory. In order to accommodate the Plug unit, a small tree similar to the one behind the fuel cell had to be removed. The ground was excavated approximately six inches to provide a sub base of granite crush. Twelve-inch pavers were laid over the crush to match the unit's footprint, and then framed with a 2" X 6" treated pine border. Access to the Environmental Building's mechanical room is through the red door in the left background. It houses electrical panels to make the fuel cell connection to the facility, and the water source for the PEM unit. No construction permits were required to install this site.

Plug Power SU-1 PEM Fuel Cell, S/N SU01B0 000000002
Figure 1

The installation tasks were completed on September 19, 2002, after spending 176 man-hours in the process. LOGAN attempted initial start of the Fort Bragg fuel cell on September 20, 2002, but was not successful due to electrical and mechanical problems that needed troubleshooting and correction. These included the failure of the therminol level sensor, rapid depletion of the batteries following unsuccessful start attempts and improper ATO setpoints in the controller software. Please see the work log dated September 20, 2002 in Appendix 3 for more details. The first successful start took place on September 30, 2002, and the 8-hour acceptance test on October 1, 2004.

This unit required greater effort to install and pass the acceptance test than anticipated. For these reasons, the actual first cost reported in Section 13.0 is significantly higher than the estimated first cost reported in the Initial Report. The cost increase reported in Section 13 is due to the extra time spent in technical services for troubleshooting and repairing the unit during the installation and start-up process.

From the outset the Ft Bragg unit has performed below execrations and has thus far failed the Program goal of 90% operational availability. LOGAN believes that the reconditioned unit provided for this site was ill suited for the task. The site work logs attached below as Appendix 3 chronicle 8 months of maximum effort in pursuit of this goal. Close scrutiny of the logs raises the notion that the electrical and mechanical deficiencies uncovered in the unit are systemic and need correction at the factory level.

This project has provided LOGAN with an unexpected early exposure to major PEM overhaul and maintenance tasks, including rebuilding reformers, replacing cell stacks and rebuilding inverters; even to inventing field modifications and service procedures to impress performance, while continuous troubleshooting episodes have covered every possible system deficiency. The learning curve experience that is occurring at this site normally requires years of field service, and would not be highlighted in this discussion were this unit operating at 90%. It is clear to LOGAN that what must be judged as this project's availability shortcomings in the strictest sense; the same is actually edifying the broader Program objectives through a rapid transfer of knowledge and experience.

Figure 2, below, diagrams the location of the fuel cell pad in relationship to the utility interfaces including, power and water in the adjacent mechanical room, and natural gas on the opposite side of the building. The natural gas piping run is approximately 50 feet, the R/O water-piping run is approximately 25 feet, and the electrical conduit run is approximately 25 feet. The unit is installed in a grid parallel / grid synchronized configuration and operates nominally at 2.5 kilowatts. A Plug Power supplied Reverse Osmosis water filtration system was diagramed in Figure 2 provides filtered process water to the power plant.

9.0 Electrical System

The SU-1 inverter has a power output of 120/240 VAC at 60 Hz. However, the distribution panel in the mechanical room has connected loads at 110/208 VAC. In order to accommodate the facility's electric service, LOGAN installed a 240/208 step-down transformer to match the requirements of the 110/208-load panel indicated in Figure 2. Also, a 60-amp service disconnect and a protective relay were installed as precautionary devices to prevent injury to service or utility personnel. The line diagram in Figure 2 below illustrates the methods and components used to complete the electrical installation.

Ft Bragg PEM Demonstration Site Layout

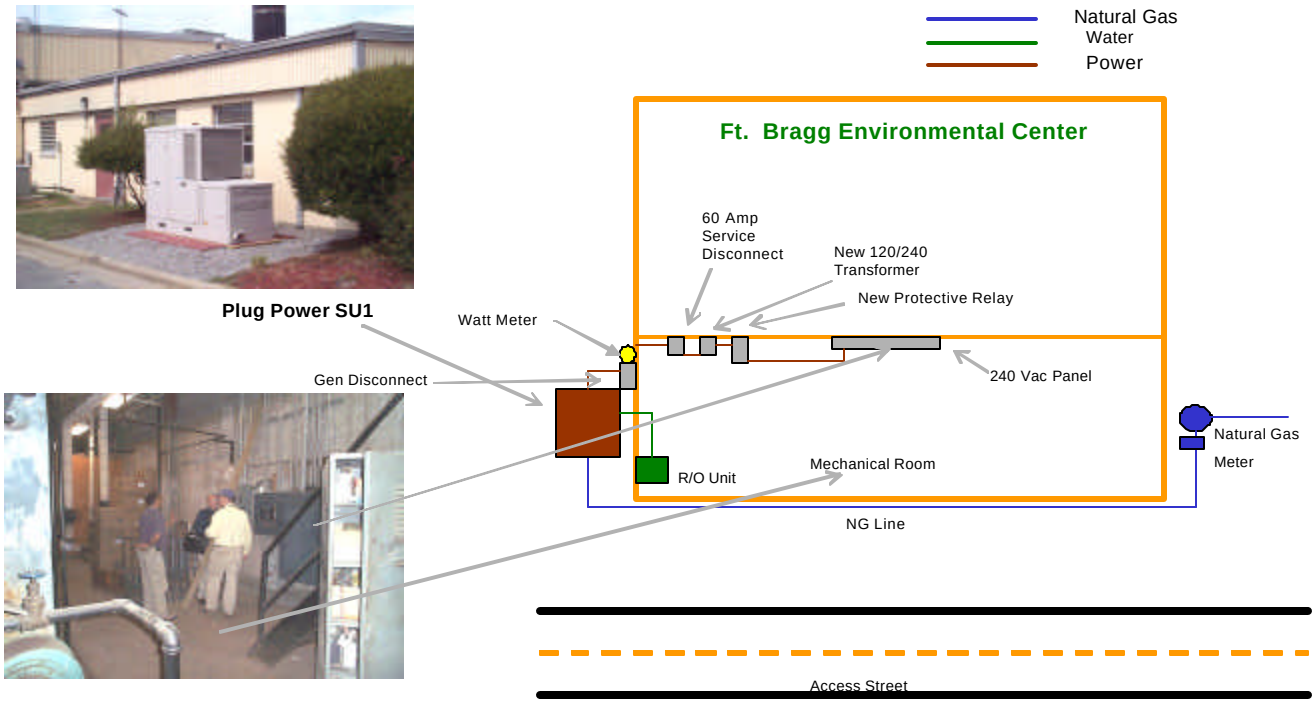

Figure 2

10.0 Thermal Recovery

Not Applicable

11.0 Data Acquisition System

Over the course of developing the several sites in the Fy01 PEM Program, LOGAN has encountered great difficulty in acquiring a dedicated fuel cell phone line to support project communications. Ft Bragg proved to be the exception to the rule as the base provided a discrete line to the fuel cell modem in three weeks.
During the period October 2002 to August 2003, LOGAN's field service technicians performed their tasks with the support of a very rudimentary SCADA system developed by Plug Power for communicating with deployed units. This system provided one-way communication from each unit to Plug's customer support center, allowing the unit to call in overnight to download a data package and an operating status report. However, LOGAN realized very quickly that the system was inadequate and unreliable to provide the high level of communications support needed for its wide-ranging PEM demonstration program. At times a unit called in and provided only partial data or incorrect data. This created uncertainty in troubleshooting and further delay in restoring

units to service. On other occasions a unit might fail to call in for a week or more frustrating the normal chain of events leading to a service advisory. While much can be said about the early learning curve experience in developing service norms, the weakness of the SCADA system became a major source of dissatisfaction with Plug Power. Under the circumstances the only means of determining a unit's actual status was to make a service call to the site. However, the scope of LOGAN's PEM program required a better solution. Finally, in March 2003 an event occurred that gave Plug direct insight into the shortcomings of its SCADA system. After advising of a shutdown at Ft Bragg, Plug sent its own technician to the site because LOGAN's technicians were servicing other units. The technician flew from Albany, NY to Raleigh, NC and then drove out to the site. Upon arriving, the technician discovered that the unit was operating normally. Indeed the SCADA system was not.

This event was an important turning point for the LOGAN/Plug Power relationship and its cooperative efforts in achieving the goals of the PEM Demonstration Program. Six weeks later in early June, six representatives from LOGAN and eight from Plug Power met in Atlanta for two days of forthright discussions. The meeting focused on short-term methods and longer term solutions to improve remote PEM fuel cell performance. Most significantly Plug determined that it would institute immediate software changes and upgrades to insure the accuracy of fuel cell data communications. Plug also promised to initiate a design change to its SCADA system that would permit bi-directional remote communications with the fuel cell controller. More importantly Plug promised that LOGAN's technicians would be able to remotely troubleshoot, change set points and attempt restarts under some circumstances. Lastly they also promised that they would publish a daily status report covering all of LOGAN's units. By early August Plug began sending daily status reports, and by mid September Plug shipped LOGAN's technician's new control software that permits remote diagnostics, monitoring, troubleshooting, and restart capabilities. Since the introduction of this new service capability along with the adoption of improved service techniques to go with it, fleet performance, availability and operating costs have begun to show positive new trends.

An external four-channel Ultralite data-logger provides data retrieval and storage at the site. Both the wattmeter, and the new fuel cell natural gas meter, diagramed in Figure 2, transmit information to the logger. This data may be viewed in Monthly Performance Data found in Appendix 1 below.

12.0 Fuel Supply System

A natural gas meter on the opposite side of the Environmental Center provides gas service to the fuel cell. A regulator was installed at the fuel cell gas inlet to maintain fuel cell inlet pressure at 10 to 14 inches water column (IWC). Both components and a line diagram of the natural gas supply may be seen in Figure 2.

13.0 Installation Costs

Fort Bragg Army Base, NC

Project Utility Rates	
1) Water (per 1,000 gallons)	$2.29
2) Utility (per KWH)	$0.0467
3) Natural Gas (per MCF)	$6.25

First Cost	**Estimated**	**Actual**
Plug Power 5 kW GenSys5C	$ 42,500.00	$ 42,500.00
Shipping	$ 1,000.00	$ 900.00
Installation electrical	$ 4,200.00	$ 3,835.00
Installation mechanical & thermal	$ 2,400.00	$ 2,100.00
Watt Meter, Instrumentation, Web Package	$ 800.00	$ 947.00
Site Prep, labor materials	$ 925.00	$ 720.00
Technical Supervision/Start-up	$ 6,500.00	$ 15,885.00
Training	$ 5,000.00	$ 5,392.00
Total	**$ 63,325.00**	**$ 72,279.00**
Assume Five Year Simple Payback	$ 12,665.00	$ 14,455.80

Forcast Operating Expenses	Volume	$/Hr	$/ Yr	
Natural Gas Mcf/ hr @ 2.5kW	0.03	$ 0.21	$ 1,618.09	
Water Gallons per Year	14,016		$ 32.10	
Total Annual Operating Cost				$ 1,650.19

Economic Summary			
Forcast Annual kWH		19710	
Annual Cost of Operating Power Plant	$	0.084	kWH
Credit Annual Thermal Recovery	$	-	kWH
Project Net Operating Cost	$	0.084	kWH
Displaced Utility cost	$	0.047	kWH
Energy Savings (Cost)		($0.037)	kWH
Annual Energy Savings (Cost)		($729.73)	

Explanation of Calculations:

Actual First Cost Total is a *sum* of all the listed first cost components.
Assumed Five Year Simple Payback is the Estimated First Cost Total *divided by* 5 years.
Forecast Operating Expenses:

Natural gas usage in a fuel cell system set at 2.5 kW will consume 0.033 Mcf per hour. The cost per hour is 0.033 Mcf per hour *x* the cost of natural gas to Bragg at $6.25/MCF. The forecast cost per year at $1618.09 is the gas cost per hour of $0.21 *x* 8760 hours per year *x* 0.9. The 0.9 represents 90% availability.

Natural gas fuel cell systems set at 2.5 kW will consume 1.6 gallons of water per hour through the DI panel. The total volume of water consumed at 14,016 gallons per year is 1.6 gph *x* 8760 hours per year times 90% availability. The cost per year at $32.10 is 14,016 gph *x* cost of water to Bragg at $2.29 per 1000 gallons times availability.

The Total Annual Operating Cost, $1650.19 is the *sum of* the cost per year for the natural gas and the cost per year for the water consumption.

Economic Summary:

The Forecast Annual kWh at 19,710 kWh is the product of 2.5 kW set point for the fuel cell system *x* 8760 hours per year *x* 0.9. The 0.9 is for 90% availability.

The Annual Cost of Operating the Power Plant at $0.084 per kWH is the Total Operating Cost at $1650.19 *divided by* the forecast annual kWh at 19,710 kWh.

Credit for Annual Thermal Recovery is not applicable for this demonstration.

The Project Net Operating Cost is the *sum* of the Annual Cost of Operating the Power Plant *plus* the Credit Annual Thermal Recovery.

The Displaced Utility Cost is the kWh cost of utility service at the site.

Energy Savings (increase) equals the Displaced Utility Cost *minus* the Project Net Operating Cost.
Annual Energy Savings (increase) equals the Energy Savings *x* the Forecast Annual kWh.

14.0 Acceptance Test

On October 1, 2002 the unit completed its 8-hour acceptance test. Please see Appendix 1 for documentation of the installation start checklist and the acceptance test.

Appendix

1) Monthly Performance Data
2) Commissioning and Acceptance Test Report
3) Work Logs

1) Monthly Performance Data

Monthly Performance Data
Fort Bragg

	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03
Run Time (Hours)	423	661	1204	1809	1999	1999	2306	2904	35
Time in Period (Hours)	720	744	1488	2160	2904	3624	4368	5088	58
Availability (%)	58.8%	88.8%	80.9%	83.8%	68.8%	55.2%	52.8%	57.1%	60.9
Energy Produced (kWe-hrs AC)	1058	1911	3521	5126	5557	5557	6289	7784	93
Output Setting (kW)	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.5
Average Output (kW)	2.67	2.89	2.93	2.83	2.78	2.78	2.73	2.68	2.(
Capacity Factor (%)	29%	51.4%	47.3%	47.5%	38.3%	30.7%	28.8%	30.6%	32.2
Fuel Usage, HHV (BTUs)	14339700	26122272	45819066	68007643	75162334	75162334	85860523	107898631	1303257(
Fuel Usage (SCF)	14636	25824	45297	67232	74305	74305	84882	106669	1288
Electrical Efficiency (%)	22%	25.0%	26.2%	25.7%	25.2%	25.2%	25.0%	24.6%	24.6
Thermal Heat Recovery (BTUs)		0	0	0	0	0	0	0	
Heat Recovery Rate (BTUs/hour)		0	0	0	0	0	0	0	
Thermal Efficiency (%)		0	0	0	0	0	0	0	
Overall Efficiency (%)	22%	25.0%	26.2%	25.7%	25.2%	25.2%	25.0%	24.6%	24.6
Number of Scheduled Outages	0	0	0	0	0	0	0	0	
Scheduled Outage Hours	0	0	0	0	0	0	0	0	
Number of Unscheduled Outages		1	2	3	7	7	9	10	
Unscheduled Outage Hours	297	83	285	351	905	1625	2062	2184	22

2) Installation Checklist and Acceptance Test

2) Commissioning and Acceptance Test Report

TASK	SIGN	DATE	TIME (hrs)
Batteries Installed	MJH	9/6/02	2
Stack Installed	MJH	9/6/02	2
Stack Coolant Installed	MJH	9/12/02	1
Air Purged from Stack Coolant	MJH	9/12/02	1
Radiator Coolant Installed	MJH	9/19/02	2
Air Purged from Radiator Coolant	MJH	9/19/02	1
J3 Cable Installed	MJH	9/6/02	1
J3 Cable Wiring Tested	MJH	9/10/02	1
Inverter Power Cable Installed	MJH	9/11/02	1
Inverter Power Polarity Correct	MJH	9/12/02	1
RS 232 /Modem Cable Installed	MJH	9/30/02	1
DI Solenoid Cable Installed with Diode	MJH	9/6/02	2
Natural Gas Pipe Installed	MJH	9/4/02	10
DI Water / Heat Trace Installed	MJH	9/4/02	5
Drain Tubing Installed	MJH	9/4/02	1

TASK	SIGN	DATE	TIME (hrs)
Controls Powered Up and Communication OK	MJH	9/12/02	4
SARC Name Correct	MJH	9/12/02	1
Start-Up Initiated	MJH	9/20/02	12
Coolant Leak Checked	MJH	9/30/02	1
Flammable Gas Leak Checked	MJH	9/30/02	1
Data Logging to Central Computer	MJH	10/10/02	3
System Run for 8 Hours... OK	MJH	10/1/02	8

3) Work Logs

Daily work log for Mike Harvell
LOGANEnergy Field Technician
August 1, 2002 through July 31, 2003

Date	Activity	Hours
8/07/2002	Traveled to Ft. Bragg and met with Georges Dib regarding fuel cell location. Tried to get it as close to gas line and electric panel as possible. Seems that we have a good location figured out.	12
8/13/2002	Drove to Ft. Bragg. After a slight change in the fuel cell location, I began work on building the pad.	10
8/14/2002	Completed the pad and surrounding area. Was going to set the fuel cell but George needed more time to work out other issues. Drove back home.	12
8/23/2002	Drove to Fayetteville, set fuel cell on the pad, had a meeting with Georges Dib and both contractors, then drove back home.	12
8/26/2002	Drove to Fayetteville, straightened RFC on the pad (fork lift couldn't do it), met again with electrician, bought and placed brick pavers around FC, went out to find a security Torx T25.	9
8/27/2002	Met again with electrician. Then went through the remaining boxes that were shipped. Spent some time understanding and piecing together the R/O system. Drove home.	9
9/05/2002	Drove to Fayetteville, inspected the work that the contractors had done so far, ordered a gas pressure gauge, inspected the inside of the fuel cell for differences from the one I trained on, studied installation procedures.	8.5
9/06/2002	Installed the cell stack, helped contractor with the DI water system installation, ordered electric meter, installed the J3 control cable. Drove home.	12
9/09/2002	Drove to Fayetteville, tested gas pressure, went over the final electrical installation with the contractor, began troubleshooting wires inside the fuel cell that had no mating connections.	9
9/10/2002	Went through electrical checks in start-up procedure, did a NG purge, completed troubleshooting wires inside the fuel cell that	11

	had no connection. Drove home to pick up electric meter.	
9/11/2002	Drove back to Fayetteville. Drew wiring, gas, water and phone diagrams. Installed electric meter. Tested voltages with the electrician. Tried powering up fuel cell, but had to make 2 trips to Radio Shack for proper cable.	11
9/12/2002	Went through inverter checkout procedure, calibrated the DI water system. Filled fuel cell with cell stack coolant. Ran into computer problems that prevented some procedures from being completed. Ordered glycol fill pump from Plug.	10
9/13/2002	Waited for part to arrive. Began the glycol fill procedure but ran into the same issues with the laptop that prevented completion. Finally got Georges Dib to order the phone line. Drove home.	8
9/19/2002	Drove to Ft. Bragg. Spent time locating a cable to get new computer communicating with fuel cell. Installed system coolant.	10
9/20/2002	Tried to start unit, but had a therminol level switch shutdown. Performed troubleshooting procedure and found that the level switch is located in such a way that it collects air bubbles that make the sensor read incorrectly. Restarted unit but had a shutdown on ATO Timeout. Discovered that some values were not entered into the controller at the factory. The third start ended in a shutdown when the battery voltage got too low. Packed up and drove home.	11
9/30/2002	Drove to Ft. Bragg with new 48V battery charger. Modified the leads to work on the fuel cell. Charged batteries and started up fuel cell. Had some minor issues, but it started and ran fine.	11
10/1/2002	Fuel cell still operating. Began working on hooking up the phone line and entering controller data for the modem call out. Tested modem but could not get it to call out successfully. Working with Plug Power to resolve issue. Ran power setting up to 4kW and 5kW with no issues. Left site with the fuel cell at 2.5kW.	11
10/9/2002	Drove to Ft. Bragg. Found RFC not operating. No alarm message given, but event log showed an I2C S/D on 10/2. PLUG says it sometimes gives that message after the S/D takes place and may not be the cause. I2C is a comm failure between the SARC and the PDB. Restarted the RFC and drove home. Also got the modem working on this visit.	13
10/18/2002	Drove to Ft. Bragg. RFC not operating. DI tank was low and caused S/D on 10/11. For some reason, there was no S/D callout. The I2C alarm could be the reason. Spent the day loading new software and t/s the DI problem. Drove home.	13
10/21/2002	Drove the Ft. Bragg. Worked out the software issue that appeared	5

	to have scrambled inputs around. Rain cut day short.	
10/22/2002	Dealt with R/O issue. Found that water pressure to panel is low. Calibrated the 7:1 flow, but pressure was only 11psi (need 40). Started RFC twice but had cathode air temp. low shutdowns.	9
10/23/2002	T/s DI RTD problem and Cathode Inlet RDT problem	12
10/29/2002	Drove to Bragg, replaced cathode inlet sensor and went for a start, but it shutdown on the same problem. Tested all related components to be sure they were working. Sent PLUG the setpoints file to hunt for software issues.	9
10/30/2002	Continued with more software adjustments and performed 3 starts, but each ended with SD's related to low cathode inlet temp.	9
10/31/2002	Still working with Tech Support Engineers to unravel mystery.	10
11/7/2002	Drove to Bragg. RFC was running but had a High H2 Stoich alert. Made adjustments to the Prox Air Solenoid to increase the voltage to the valve. Everything else looked fine. Also met with Leroy Fedd regarding data that Dr. Singh may want to have. Also met with plumber and maintenance worker to figure out if the fuel cell is robbing gas from the water heater in the basement.	10.5
11/14/2002	Loaded new parameters into RFC software and went for several more starts, but continued to have shutdowns on low cathode inlet temperature.	10
11/15/2002	Tried another start with version 1.2 software, then loaded the old 1.18 software and went for 2 more starts, but still had low cathode inlet temp. PLUG said they needed time to think about it over the weekend.	11

11/20/2002	Met a PLUG field service technician at Ft. Bragg. We tore down the reformer to install new catalyst in the LTS. Then put it all back together. We then began a six hour reduction process.	10
11/21/2002	We continued the reduction process until lunch, then loaded new software (v.1.2), then started the unit up. It ran well, but stack was in a "recovery" process for a day or two until all the carbon monoxide had been cleaned off the stack. After that, the voltage looked good. Drove back home.	11.5
01/03/03	Drove to Ft. Bragg to find the unit down and discovered the carbon filter clogged with a slimy reddish goo. Ordered new carbon and R/O filters. Downloaded data. Drove to some local places looking for filter to no avail. Drove home.	11.5
01/06/03	Received carbon filter, but not R/O. Installed and went for a start, but old R/O filter would not let enough water pass to satisfy humidifier. Drove to Ft. Jackson to get the filter out of that unit.	11
01/07/03	Drove to Bragg, installed R/O filter and started up the system. All was well when I left. System was set at 2.5kW.	7
01/08/02	System shut down soon after I left yesterday with no obvious event. Re-started unit. Stayed with it a while till everything leveled out.	7
01/16/03	System operating fine. Left it at 2.5kW.	5.5
01/21/03	System running well. Set up power to 4 kW.	9
1/29/03	System down because of timeout on Loss of Grid. Restarted with no issues. Power set at 2.5	14
2/3/03	Collected data and changed out water filters.	9
2/14/03	Fuel cell had shut down 2 days earlier due to water filter clogging. Replaced RO and carbon. Went for a start that ended with a shut down 3 hrs. later due to the DCL not staying at 55 amps for 2.5 minutes. A retry started the RFC right up.	13.5
2/15/03	Designed and built pre-filter rack for Bragg.	2

2/19/03	Hung new pre-filter rack and re-ran tubing to DI panel. RO filter was allowing just enough water through to keep RFC running. Went ahead and changed it. Gathered data.	9.5
2/25/03	Drove to Bragg from Greensboro.	2
2/26/03	Collected data, Raised kW to 4, Changed RO filter, talked with water quality dept about getting an analysis. Drove to Ft. Jackson.	6
3/5/03	RFC had a shutdown on 3/2/03 on a low therminol alarm. Filled therminol tank and installed a retrofit for a prox air valve. Installed an in-line pressure gauge just before the RO filter to see if DI problem is pressure related. Checked out filters and they were all clean (to my surprise). Sent 3 water samples and an RO filter to plug for testing. Restarted fuel cell.	11
3/10/03	RFC shut down yesterday on a low cell trip alarm. Reseated scanner card and checked coolant level then restarted. Since it was cell #88 (top of stack), coolant flow may be deficient. DI pressure still at 52psi and seems to be working well.	
3/18/03	Fuel cell shutdown on the 14th with no communication (did not know it was down). Low cell trip again. Flashed new software and raised cathode air minimum to a higher voltage.	7
3/19/03	Started fuel cell (with a little trouble).	5.5
3/21/03	Another low cell trip shutdown. Restarted after disabling stack recovery setpoints.	9.5
April, 2003	Fuel cell shut down for entire month while Plug Power analyses data and decides what to do next.	
5/07/03	Prepared for and drove to Fayetteville for system overhaul.	3
5/08/03	Replaced stack , scanner cards, SARC board, enthalpy wheel, and glycol. Removed glycol strainer from system. Removed SARC and put old one back in after confusion over TC and RTD calibrations. New scanner cards would not work, so we (Ed from Plug) re-installed the old ones. Started system but cell #5 was very low. Before starting we flushed the glycol system with distilled water to remove problem debris and filter.	10
5/09/03	Arrived to find cell #5 still low. Tried raising cathode air flow, but no change. Shut system down to replace master scanner card, but couldn't get scanner communication with it -- put old one back in and re-started. Also changed out 2 batteries (2 on the left). Cell 5 looked better when we left.	6
5/14/03	RFC shut down over the weekend. Drove to site and changed out carbon and RO filters. Started up, but cell 5 still showing weakness. Shut system down and changed out master scanner with new one. Re-started, but SARC is reading cell 5 correctly (checked it with DVM). But, cell 5 recovers to near the average after system gets good and hot. Plug thinks it will	12.5

	eventually recover to normal.	
5/28/03	Shut down on low DI tank, but filters and DI flow appeared to be fine, so I restarted and all was well when I left.	6
6/09/03	Studied Dick's new filtration plan and ordered supplies to build it.	2
6/10/03	Read the meters. Downloaded fuel cell data. Input new callout parameters. Tested conductivity. Had a couple of "AC Output Limited by Stack" events. Cells 1 and 5 were low. There were also some low cell trips. Changed carbon and RO filters.	5.5
6/11/03	Emptied and refilled a resin bottle for use in the DI system.	1.5
6/17/03	Changed filters. All of flow was going to unit.	5.5
6/24/03	Drove to Fayetteville.	3
6/25/03	Installed new filtration system (3 new 20" filters) and changed both filters on DI panel.	10
6/30/03	Installed new cell stack, cleaned one of the manifold floats that was dirty, installed single vent therminol tank vent line retrofit. Started up fuel cell. Also checked for sulfur smell from the HDS canister. Fuel cell shut down on a DCL timeout after leaving site.	11.5
7/01/03	Fuel cell shut down the night before on a DCL timeout. Restarted today.	4
7/08/03	Changed desulferizer tank. Installed the new 20" 1 micron prefilter canister. Installed new P10 inverter retrofit. Changed out o-rings that were leaking on DI lines near reformer.	11
7/28/03	Gathered monthly data. Checked out system.	